

# Dietary Reference Intakes

## Proposed Definition and Plan for Review of Dietary Antioxidants and Related Compounds



A Report of the  
Standing Committee on the Scientific Evaluation of  
Dietary Reference Intakes and Its Panel on  
Dietary Antioxidants and Related Compounds

Food and Nutrition Board

INSTITUTE OF MEDICINE



NATIONAL ACADEMY PRESS  
Washington, D.C. 1998

NATIONAL ACADEMY PRESS • 2101 Constitution Avenue, N.W. • Washington, DC 20418

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

The Institute of Medicine was established in 1970 by the National Academy of Sciences to enlist distinguished members of the appropriate professions in the examination of policy matters pertaining to the health of the public. In this, the Institute acts under both the Academy's 1863 congressional charter responsibility to be an adviser to the federal government and its own initiative in identifying issues of medical care, research, and education. Dr. Kenneth I. Shine is president of the Institute of Medicine.

This project was funded by the U.S. Department of Health and Human Services Office of Disease Prevention and Health Promotion, Contract No. 282-96-0033; U.S. Army Medical Research and Materiel Command; Health Canada; the Institute of Medicine; and the Dietary Reference Intakes Corporate Donors' Fund. Contributors to the Fund include Roche Vitamins, Inc.; Mead Johnson Nutrition Group; Daiichi Fine Chemicals, Inc.; Kemin Foods, Inc.; M&M Mars; Weider Nutrition Group; and the Natural Source Vitamin E Association. The opinions or conclusions expressed herein do not necessarily reflect those of the funders.

**International Standard Book No. 0-309-06187-3**

The final version of *Dietary Reference Intakes: Proposed Definition and Plan for Review of Dietary Antioxidants and Related Compounds* will be available for sale from the National Academy Press, 2101 Constitution Avenue, N.W., Box 285, Washington, DC 20055; call (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area), or visit the NAP's on-line bookstore at [www.nap.edu](http://www.nap.edu).

For more information about the Institute of Medicine or the Food and Nutrition Board, visit the IOM home page at [www2.nas.edu/iom](http://www2.nas.edu/iom).

Copyright 1998 by the National Academy of Sciences. All rights reserved.

Printed in the United States of America

The serpent has been a symbol of long life, healing, and knowledge among almost all cultures and religions since the beginning of recorded history. The image adopted as a logotype by the Institute of Medicine is based on a relief carving from ancient Greece, now held by the Staatliche Museen in Berlin.

## **PANEL ON DIETARY ANTIOXIDANTS AND RELATED COMPOUNDS**

**NORMAN I. KRINSKY** (*Chair*), Department of Biochemistry, Tufts University

**GARY R. BEECHER**, U.S. Department of Agriculture Beltsville Human Nutrition Research Center, Beltsville, Maryland

**RAYMOND F. BURK**, Nutrition Center, Vanderbilt University Medical Center

**ALVIN C. CHAN**, Department of Biochemistry, University of Ottawa, Canada

**JOHN W. ERDMAN, Jr.**, Division of Nutritional Sciences, College of Agricultural, Consumer, and Environmental Sciences, University of Illinois at Urbana-Champaign

**ROBERT A. JACOB**, U.S. Department of Agriculture Western Human Nutrition Research Center, Presidio of San Francisco

**ISHWARLAL JIALAL**, Department of Pathology and Internal Medicine, University of Texas Southwestern Medical Center, Dallas

**JAMES R. MARSHALL**, Cancer Prevention and Control, Arizona Cancer Center, University of Arizona

**SUSAN TAYLOR MAYNE**, Department of Epidemiology and Public Health, Yale University School of Medicine

**ROSS L. PRENTICE\*** Division of Public Health Sciences, Fred Hutchinson Cancer Research Center, Seattle

**DANIEL STEINBERG, \*†** Division of Endocrinology and Metabolism, University of California at San Diego

**MARET G. TRABER**, Department of Nutrition and Food Management, and the Linus Pauling Institute, Oregon State University

### *Food and Nutrition Board Liaison*

**CHARLES H. HENNEKENS**, Department of Medicine, Ambulatory Care, and Prevention, and Division of Preventive Medicine, Harvard Medical School

### *U.S. Government Liaison*

**LTC KARL FRIEDL**, U.S. Army Medical Research and Materiel Command, Ft. Detrick, Maryland

### *Staff*

**SANDRA A. SCHLICKER**, Study Director

**MARY I. POOS**, Senior Staff Officer

**ELISABETH A. REESE**, Research Associate

**ALICE L. KULIK**, Research Associate

**MICHELE R. RAMSEY**, Project Assistant

---

\*Member, Institute of Medicine.

†Member, National Academy of Sciences.

**STANDING COMMITTEE ON THE SCIENTIFIC EVALUATION OF  
DIETARY REFERENCE INTAKES**

**VERNON R. YOUNG** (*Chair*),<sup>\*†</sup> Laboratory of Human Nutrition, School of Science, Massachusetts Institute of Technology

**JOHN W. ERDMAN, JR.** (*Vice-Chair*), Division of Nutritional Sciences, College of Agricultural, Consumer, and Environmental Sciences, University of Illinois at Urbana-Champaign

**JANET C. KING** (*Vice-Chair*),<sup>\*</sup> University of California at Berkeley and U.S. Department of Agriculture Western Human Nutrition Research Center, Presidio of San Francisco

**LINDSAY H. ALLEN**, Department of Nutrition, University of California at Davis

**STEPHANIE A. ATKINSON**, Department of Pediatrics, Faculty of Health Sciences, McMaster University, Canada

**JOHANNA T. DWYER**, Frances Stern Nutrition Center, New England Medical Center, Boston, and Tufts University

**JOHN D. FERNSTROM**, University of Pittsburgh School of Medicine, Western Psychiatric Institute and Clinic

**SCOTT M. GRUNDY**,<sup>\*</sup> Center for Human Nutrition, University of Texas Southwestern Medical Center, Dallas

**CHARLES H. HENNEKENS**, Department of Medicine, Ambulatory Care, and Prevention and Division of Preventive Medicine, Harvard Medical School

**SANFORD A. MILLER**, Graduate School of Biomedical Sciences, University of Texas Health Science Center, San Antonio

*U.S. Government Liaison*

**LINDA MEYERS**, Office of Disease Prevention and Health Promotion, U.S. Department of Health and Human Services, Washington, D.C.

*Canadian Government Liaison*

**PETER W.F. FISCHER**, Nutrition Research Division, Health Protection Branch, Health Canada, Ottawa

*Staff*

**ALLISON A. YATES**, Study Director

**SANDRA SCHLICKER**, Senior Program Officer

**MARY POOS**, Senior Program Officer

---

<sup>\*</sup>Member, Institute of Medicine.

<sup>†</sup>Member, National Academy of Sciences.

**ELISABETH A. REESE**, Research Associate  
**ALICE L. KULIK**, Research Associate  
**MICHELE RAMSEY**, Project Assistant  
**GAIL E. SPEARS**, Administrative Assistant

## FOOD AND NUTRITION BOARD

**CUTBERTO GARZA** (*Chair*), Division of Nutrition, Cornell University  
**JOHN W. ERDMAN, JR.** (*Vice-Chair*), Division of Nutritional Sciences,  
College of Agricultural, Consumer and Environmental Sciences, University  
of Illinois at Urbana-Champaign  
**LINDSAY H. ALLEN**, Department of Nutrition, University of California at  
Davis  
**BENJAMIN CABALLERO**, Center for Human Nutrition, Johns Hopkins  
School of Hygiene and Public Health  
**ROBERT J. COUSINS**, Center for Nutritional Sciences, University of Florida  
**FERGUS M. CLYDESDALE**, Department of Food Science, University of  
Massachusetts at Amherst  
**JOHANNA T. DWYER**, Frances Stern Nutrition Center, New England Medical  
Center, Boston, and Tufts University  
**SCOTT M. GRUNDY**,\* Center for Human Nutrition, University of Texas  
Southwestern Medical Center, Dallas  
**CHARLES H. HENNEKENS**, Department of Medicine, Ambulatory Care, and  
Prevention, and Division of Preventive Medicine, Harvard Medical School  
**SANFORD A. MILLER**, Graduate School of Biomedical Sciences, University  
of Texas Health Science Center, San Antonio  
**ROSS L. PRENTICE**,\* Division of Public Health Sciences, Fred Hutchinson  
Cancer Research Center, Seattle  
**A. CATHARINE ROSS**, Department of Nutrition, Pennsylvania State  
University  
**ROBERT E. SMITH**, R.E. Smith Consulting, Inc., Newport, Vermont  
**VIRGINIA A. STALLINGS**, Division of Gastroenterology and Nutrition,  
Children's Hospital of Philadelphia  
**VERNON R. YOUNG**,\*† Laboratory of Human Nutrition, School of Science,  
Massachusetts Institute of Technology

### *Ex-Officio Member*

**STEVE L. TAYLOR**, Department of Food Science and Technology and Food  
Processing Center, University of Nebraska at Lincoln

---

\*Member, Institute of Medicine.

†Member, National Academy of Sciences.

*Staff*

**ALLISON A. YATES**, Director

**GAIL E. SPEARS**, Administrative Assistant

**CARLOS GABRIEL**, Financial Associate

## REVIEWERS

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the Institute of Medicine in making the published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The content of the final report is the responsibility of the Institute of Medicine and the study committee and not the responsibility of the reviewers. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. The committee wishes to thank the following individuals, who are neither officials nor employees of the Institute of Medicine, for their participation in the review of this report:

**BALZ FREI**, Linus Pauling Institute, Oregon State University;  
**LESTER PACKER**, University of California at Berkeley;  
**WILLIAM A. PRYOR**, Biodynamics Institute, Louisiana State University;  
**CATHERINE RICE-EVANS**, King's College, UMDS Guy's Hospital,  
London, England;  
**HELMUT SIES**, Heinrich-Heine-Universität, Düsseldorf, Germany;  
**JUDITH STERN**,\* University of California at Davis; and  
**ROGER A. SUNDE**, University of Missouri-Columbia.

While the individuals listed above have provided many constructive comments and suggestions, responsibility for the final content of this report rests solely with the authoring committee and the Institute of Medicine.

---

\*Member, Institute of Medicine.



# Contents

<b>INTRODUCTION</b> .....	1
<b>TOWARD A DEFINITION OF <i>DIETARY ANTIOXIDANT</i></b> .....	2
Possible Health Benefits, 3	
<b>PROPOSED DEFINITION</b> .....	3
Presence in Human Diets, 3	
Measurement of Quantities in Foods, 4	
Decreased Adverse Effects of Some ROS and RNS, 4	
<b>FOOD COMPONENTS THAT WILL BE REVIEWED BY THE PANEL</b> .....	6
Beta-Carotene and Other Carotenoids, 6	
Vitamin C, 7	
Vitamin E, 7	
Selenium, 8	
<b>FOOD COMPONENTS THAT WILL NOT BE REVIEWED BY THE PANEL</b> .....	8
Phenols and Polyphenols, 8	
Other Proposed Dietary Antioxidants, 8	
<b>SUMMARY</b> .....	8
<b>SELECTED REFERENCES</b> .....	9
<b>APPENDIX: ACKNOWLEDGMENTS</b> .....	13

